

ASSESSING THE EFFECT OF SIMULATED PHYSICAL OBJECTS AND
ELEMENTS IN VIRTUAL ENVIRONMENTS ON SOCIAL INFLUENCE

by

Brian Thomas Johnson

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A thesis submitted in partial fulfillment
of the requirements for the Master of
Arts degree in Sociology
in the Graduate College of
The University of Iowa

July 2006

Thesis Supervisor: Associate Professor Lisa Troyer

20060808101

AUG 03 2006

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE 2.Aug.06		3. REPORT TYPE AND DATES COVERED THESIS	
4. TITLE AND SUBTITLE ASSESSING THE EFFECT OF SIMULATED PHYSICAL OBJECTS AND ELEMENTS IN VIRTUAL ENVIRONMENTS ON SOCIAL INFLUENCE				5. FUNDING NUMBERS	
6. AUTHOR(S) 2D LT JOHNSON BRIAN T					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) THE UNIVERSITY OF IOWA				8. PERFORMING ORGANIZATION REPORT NUMBER CI04-1835	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) THE DEPARTMENT OF THE AIR FORCE AFIT/CIA, BLDG 125 2950 P STREET WPAFB OH 45433				10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES					
12a. DISTRIBUTION AVAILABILITY STATEMENT Unlimited distribution In Accordance With AFI 35-205/AFIT Sup 1				12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words)					
14. SUBJECT TERMS				15. NUMBER OF PAGES 50	
				16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT		

Graduate College
The University of Iowa
Iowa City, Iowa

CERTIFICATE OF APPROVAL

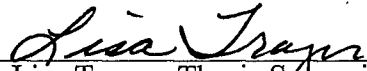
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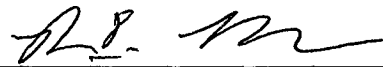
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Brian Thomas Johnson

has been approved by the Examining Committee
for the thesis requirement for the Master of Arts
degree in Sociology at the July 2006 graduation.

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ABSTRACT

Previous research has shown that colors, textures, and objects in a physical space can influence the attitudes and behaviors of people within that space. No research, however, has been conducted on the importance of colors, textures, and objects in virtual spaces. Specifically, the effect that these objects and elements might have on one's susceptibility to social influence in a virtual space has not been investigated. A mechanism is proposed that leads to the hypothesis that as colors, textures, and objects are added to virtual space, then occupants or observers of that space become more likely to be influenced by other people in that space. While the participants who observed virtual spaces with colors, textures, and objects were more likely to be influenced than participants who observed the same spaces without colors, textures, and objects, the social influence measure was not significantly different across condition. An interesting finding, however, is that more influence occurred across all conditions than would have been expected in a face-to-face setting, as opposed to a computer-mediated setting. More research is warranted to understand how social psychological processes operate in computer-mediated settings and, more specifically, in virtual space.

The views expressed in this article are those of the author and do not reflect the official policy or position of the United States Air Force, Department of Defense, or the U.S. Government.

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INTRODUCTION

Virtual environment technology (VET) has made great advances over the last few decades. A variety of applications have taken advantage of VET's versatile utility, including state-of-the-art flying and driving simulators, vehicle design, and training modules (Brooks, 1999). VETs have even made their way into the realm of psychology, being used as a tool in therapy for overcoming many phobias (Brooks, 1999). In addition to therapy, VET promises to be useful for other applications, including those pertaining to social psychology. Specifically, I am interested in the efficacy of VET for studying social influence (i.e., the effects of the actual or implied presence of others on one's attitudes and behaviors

The benefits of using VET for studying social influence are numerous, such as offering superior amounts of control and the ability to test the effects of variables that are difficult to manipulate. Before much time and money is invested in studying social influence via VET, however, it is important to understand what conditions are necessary for social influence to occur within virtual environments (VEs). Previous researchers have suggested that the perceived realness of the behavior of simulated humans and other objects affects social influence in VEs (Blascovich, 2002; Blascovich et al., 2002), but no research has addressed the importance of non-agent objects in the virtual environment and how they may contribute to a "socialness" of the virtual environment. Do the simulated physical properties and presence of certain objects in a virtual environment affect social influence? My study addresses this question.

THEORETICAL BACKGROUND

Virtual Environments

Following the lead of Blascovich, et al. (2002), I define a VE as “synthetic sensory information that leads to perceptions of environments and their contents as if they were not synthetic.” A virtual display (VD) is a digitally manipulated display by which the human senses are stimulated (Loomis, Blascovich, & Beall, 1999). VDs can include desktop computer monitors, single projector displays, multiple projector displays (i.e., “caves”), or displays that are generated from a head-mounted device. The latter two examples result in an immersive virtual environment (IVE), a VE that completely surrounds the visual field of the user (Blascovich et al., 2002). Virtual environment technology refers to both virtual environments and virtual displays and results in users perceiving the synthetic sensory stimulations produced by them as real (Blascovich et al., 2002).

Using Virtual Environments to Study Psychological

Processes

There may be many advantages of using VEs as a means of studying psychological processes. These potential advantages are pointed out by Loomis, Blascovich, & Beall (1999). Perhaps the most compelling advantage of using VEs to study psychological processes is that VEs allow variables that usually occur simultaneously in the physical world to be isolated from one another in ways that are difficult or impossible via other means (Loomis, Blascovich, & Beall, 1999). For example, the use of VEs could allow an experimenter to couple a female voice with a male avatar. Doing so might allow an experimenter to isolate the effect of voice and the effect of physical appearance when studying social influence. Also, VEs could allow variables that are hard to manipulate or rare in some regions of physical world to be introduced, such as skin color, weight, and facial deformities (Hebl & Kleck, 2002). For

example, the skin color of a confederate is nearly impossible to manipulate, especially for the sole purpose of a experiment. While experimenters can utilize confederates with different skin colors in an experiment, the amount of experimental control suffers because the same confederate may not participate in all trials of the experiment. VET offers an alternative that would allow an experimenter to change the skin color of an avatar while maintaining control over all other factors in the experiment.

The potential advantages of using VEs to study psychological processes present researchers with a new tool, and with new research tools comes the ability to acquire new information. Researchers who study the psychological process of social influence stand to gain a wealth of knowledge by using VEs as a research tool, such as learning the effects of variables that are difficult to manipulate or isolate. While VEs may presumably be used to develop new theories of social influence, they can also be used to gain additional information about existing theories. My interest is to use VEs as a means of conducting further study using status characteristics theory, a theory of social influence.

Status Characteristics Theory

Status characteristics theory (SCT) (Berger, Cohen, & Zelditch, 1972) describes the social influence process among group members when the group members are differentiated along a social attribute, such as sex, age, or race. The theory proposes that differing states of these status characteristics have pre-determined performance expectations attributed to them. Higher states (i.e., higher status) are attributed to higher performance expectations and lower states (i.e., lower status) are attributed to lower performance expectations. These performance expectations derived from status characteristics reflect beliefs that are pervasive in society or arise through information given to group members. These beliefs create expectations about the competency and worthiness of different group members based on the state of a status characteristic group

members occupy vis-à-vis one another. These competency expectations facilitate the creation of a power prestige order in the group. Individuals who occupy higher status and are therefore higher on the power prestige order are expected to be more competent than group members lower on the power prestige order. This power prestige order becomes the basis for social influence when group members interact with each other to complete some task, allowing higher-status group members to exercise more influence than lower-status group members. As a result, SCT claims that status, competency expectations, and therefore influence can arise when group members are differentiated from one another based on some status characteristic as long as that status characteristic has not been shown to be specifically irrelevant to the group task. This influence manifests itself when groups are task-oriented and collectively oriented. A group is task-oriented if members believe that there is some correct answer or valued end on a group task and they are seeking that end. A group is collectively oriented if members believe that it is important to take into consideration input from other group members. These conditions are the scope conditions of the theory (Cohen, 1989; Walker and Cohen, 1985).

SCT research has experienced tremendous advancement over the years because of adherence to a standardized experimental setting (SES) by researchers (Troyer, 2002). This SES, presented in Troyer (2002), allows researchers to compare results from different SCT studies because of the standardized operating procedures of the SES. The SES standardizes the operationalization of theoretical variables, such as status characteristics, through explicit procedures designed to manipulate independent variables consistently across studies. The SES also provides standardized participant instructions and debriefing procedures, guidance on how to assess the effects of these independent variables (e.g., measuring influence), and guidance on how to ensure that the scope conditions of the theory (i.e., task orientation and collective orientation) are met.

Studying Social Influence in Virtual Environments

Some research has been conducted on social influence as it occurs via computer-mediated communication (CMC), such as e-mail or chat-rooms. Kiesler and her colleagues contend that CMC attenuates social context cues, and therefore reduces social influence, compared to comparable face-to-face settings (Dubrovsky, Kiesler, & Sethna, 1991; Kiesler, Siegel, & McGuire, 1984; Sproull & Kiesler, 1986). VEs, however, are much different than other forms of CMC. Whereas in other types of CMC users may not have a visual representation of the person with whom they are communicating, VEs allow users to see a virtual, visual representation of other people. It is this representation that Blascovich and his colleagues argue affects social influence in VEs (Blascovich et al., 2002; Blascovich, 2002). They propose that social influence in VEs results from two complementary factors – behavioral realism and social presence. Behavioral realism refers to the extent to which visual representations of humans and other objects in VEs behave as if they were in a realistic physical environment. Social presence refers to how much the user believes that he or she is actually interacting with another real human being within the VE.

It is important to note a distinction between the definition of social influence used by Blascovich et al. (2002) and Blascovich (2002) and the definition used by status characteristics theory researchers. On the one hand, the definition of social influence that Blascovich and his colleagues use is quite broad and refers to the effect that actual or implied others have on one's attitudes and behavior. On the other hand, the definition of social influence adhered to by status characteristics theory researchers is much more specific and is defined as one's ability to affect change in another's attitudes or behaviors that would not otherwise occur. Note, however, that the definition of influence found in status characteristics theory is subsumed by the Blascovich et al. (2002) and Blascovich (2002) definition. The work of Blascovich and his colleagues is relevant to studying

status characteristics theory in VEs because they assert that social psychological processes, which include status-organizing processes, may occur in VEs.

While the research by Blascovich et al. (2002) and Blascovich (2002) addresses the importance of the behavior of avatars and objects in a VE for facilitating social influence, it does not speak to how other simulated elements of the virtual physical settings could affect social influence in VEs. For example, Blascovich et al. (2002) assert that objects in a VE should behave as they would in a true physical setting, but they do not address the question of whether the actual presence of particular objects or other simple physical elements of a VE, such as wall color and textures, might be conducive to the creation of a social environment that would affect social influence behavior within.

I propose that a social environment is a space, either physical or virtual, that elicits an expectation that people will enter that space and engage in social interaction with one another or the observer(s) of the space. Also, I propose that this expected interaction is therefore subject to the social norms that guide human interaction, including status-organizing processes. The presence of wall color, textures, and objects may be cues that signal to occupants that the space they are in is a space for people where interaction may occur. Knowing that interaction may occur in an environment with the aforementioned cues, the norms that govern this interaction may become more salient to the occupants or observers of the room, such as norms about how to treat other people or scripts that guide how people act around one another. Therefore, the fact that an environment is social may affect social psychological processes in it.

The Effects of Wall Color and Room Objects on Attitudes, Behavior, and Social Interaction

Researchers have studied the effects of the physical elements of settings on the attitudes and behavior of individuals within those settings. Some research suggests that wall color and textures seem to be important aspects of an environment that affect the

attitudes and behavior of occupants. Though they did not propose a mechanism, Kwallek, Lewis, Lin-Hsiao, and Woodson (1996) found that employee behavior was significantly affected by the wall color in their offices. On a proofreading task, employees made significantly more errors when they were in a room with white walls compared to a room with blue or red walls. Pressly and Heesacker (2001) also propose that room color affects occupant behavior, but they also seem to suggest the importance of color in making an environment seem more social. In their review of counseling literature, they point out that different room colors can accentuate patient extroversion or introversion and can also affect how warm patients feel in a room. For example, they suggest that light colors (e.g., beige, tan) make a room seem larger, invoke relaxation, and encourage positive emotions. These traits seem to help counselors facilitate interaction and are thus conducive to the creation of a social environment. Therefore, when trying to create a social environment, I propose that light wall colors should be used. In addition to wall color, Pressly and Heesacker (2001) point out that including textures in a room helps convey a message of comfort and intimacy to room occupants. Comfort and intimacy also help counselors elicit interaction, suggesting that textures should be used when attempting to construct a social environment.

Similar to wall color and textures, objects within a room also seem to guide occupant attitudes and behavior. Studies by Maslow and Mintz (1956) and Mintz (1956) found that participants in a beautiful room decorated with beige walls, a comfortable chair, a rug, drapes, and art rated the well-being and energy of people in photographs significantly higher than participants who performed the ratings in an average or an ugly room. Also, in a study of student performance, Wollin and Montagne (1981) found that test scores were significantly higher for students taught in a room with colored walls, posters, plants, rugs, and comfortable seating, among other things, rather than in a bare room with white walls and no decorating objects. Although neither study suggests a mechanism by which these results surfaced, Wollin and Montagne (1981) report that

students in the decorated room perceived it as more pleasing and comfortable. I propose that these reported feelings elicit the creation of a social environment and it is because of this perception of a social environment that the observed behaviors transpired.

Davis (1984) proposes that the physical properties and contents of settings such as furniture, wall color, and wall ornaments communicate a message that room occupants interpret. In many cases, people try to adorn their physical environments to make other occupants feel comfortable and welcome, and therefore attempt to create a social environment. Research suggests that there are specific objects that can be added to rooms to convey this message. For example, McCaskey (1979) and Goodsell (1977) suggest that comfortable seating such as a couch or lounge chairs make visitors to an office setting feel more at ease. A feeling of ease helps facilitate social interaction. Just as comfortable seating has been shown to convey a welcoming or social atmosphere, plants and posters or artwork have also been shown to elicit a similar aura (Campbell, 1979; Goodsell, 1977, Morrow & McElroy, 1981).

In addition to making people feel more at ease or welcome in a physical environment, certain room objects have also been shown to facilitate social interaction. For example, Tausky (1980) found that removing chairs from a nurses' station decreased the amount of conversation between nurses. This suggests that chairs facilitate social interaction and help create social environments. Similarly, with the addition of objects including a plant, posters, and a rug to a room, Gifford (1988) was able to induce more communication among study participants, and this conversation was also found to be more intimate than participants in a room without the aforementioned objects. Thus, rooms with these added objects seem to elude social feelings and behavior. Finally, a study by Chaikin, Derlega, and Miller (1976) revealed that patients in therapy were more likely to self-disclose and reveal more intimate information in a room that included comfortable furniture, pictures on the walls, and rugs than in a room without these objects. Again, I argue that these physical objects are actually making occupants feel

more welcome and at ease, thus creating a social environment in which these patients feel that they can engage with their counselor.

HYPOTHESES

As I have discussed, characteristics of physical environments, such as wall color, textures, and objects in these environments may affect the extent to which the space is perceived as social. The extent to which a space is perceived as social affects the extent to which it elicits expectations of social interaction within that space. As expectations of social interaction arise in a space, the social norms that govern interaction may become more salient to the occupants and observers of that space. As a result, the social dynamics that those norms govern, such as status-organizing and social influence processes, will be more robust (i.e., their effects will be stronger). Therefore, I hypothesize the following:

Hypothesis 1: If color, textures, a potted plant, artwork, a comfortable chair, and a rug are included in a room, then occupants will perceive the environment as more social than a room without color, textures, and objects.

Hypothesis 2: If occupants feel that a room is a social environment, then they will be more obliged to uphold social expectations that govern human interaction than they would in an environment that they did not consider social.

Hypothesis 3: If occupants feel obliged to uphold social expectations, then a lower-status actor will be subject to greater influence from a higher status actor in a status-differentiated group compared to a lower-status actor who does not feel obliged to uphold social expectations.

This set of hypotheses allows me to derive the following:

Derivation: If color, textures, a potted plant, artwork, a comfortable chair, and a rug are included in a room, then a lower-status actor will be subject

to greater influence from a higher status actor in a status-differentiated group than if color, textures, and the objects were not included.

Previous research using status characteristics theory has shown that sex is a diffuse status characteristic (Foschi, 1996; Troyer, 2001; Wager, Ford, & Ford, 1986). Specifically, the male state of sex has been shown to be higher-status vis-à-vis the female state. As a result, I operationalized status through sex differences to test my hypotheses. I studied how female (lower-status) participants were influenced by male (higher-status) confederates. According to my hypotheses, I expected to find that a lower-status participant (female) would be subject to greater influence (by a higher-status male confederate) when color, textures, a potted plant, artwork, a comfortable chair, and a rug were added to a room, because these objects may facilitate the creation of a social environment where status-organizing processes become more salient, and thus their effects more robust.

METHOD

Design

To study these hypotheses, I conducted a one-factor experiment with three conditions using VEs.¹ In the first condition, the VE appears sterile to the participant to undermine the sense of a social environment. The VE consists of a room with white walls, a white ceiling, and a white floor, all having no textures. Its only contents are a ceiling-mounted projector and a projector screen. In the second condition, the VE includes the same projector and projector screen, but the programming code of the VE is altered so that the projector and walls of the VE are textured. The walls are also given a beige color. The ceiling is given a simulated texture by adding florescent lights, incandescent lights, and vents. Also, the floor is covered with blue carpet. This condition allows me to assess the effects of color and textures on the creation of a social environment in a VE. In the third condition, the VE appears exactly as it does in the second condition, but four objects are added to the room. A potted plant, a comfortable looking chair, a piece of art on the wall, and a green rug covering some of the floor are added to the VE. This condition allows me to see whether adding objects to a room with color and textures is necessary for the creation of a social environment. I operationalized and measured the socialness of the environments on the post-experiment questionnaire by asking the participants empirical questions about interactions in the virtual room in which the experiment was conducted.

Study Participants

Sixty-three female freshman and sophomores who were voluntarily-recruited from the University of Iowa participated in the study. Because sex is a status characteristic and due to the abundance of females in the participant pool, only females

¹ IRB Approval # 200601705

participated in my study. Participants were recruited in large undergraduate classes by listening to a short speech by a graduate student telling them about current research in group processes at the University. Interested participants then filled out an information sheet and were phoned to ask for their participation (see Appendix A). Over the telephone, participants were told that they would be working with a partner via a computer network on a group task and would be paid \$12.50 for their participation (see Appendix B).

Protocol and Task

In this study, I followed the protocol of the standardized experimental setting reported in Troyer (2002), altered only to test status-organizing processes in VEs. In this protocol, each participant is randomly assigned to one of the three conditions after giving informed consent (see Appendix C). In all three conditions, a research assistant seats participants in front of a desktop computer monitor displaying the VE to which they are assigned. Once participants are seated in front of the desktop computer displaying the VE, a virtual, photorealistic male experimenter walks into the VE and explains to the participant that they will be completing a task so that a newly discovered skill, contrast sensitivity, can be studied. Contrast sensitivity is explained as a skill unrelated to known abilities, such as mathematics ability or language capability. This ensures that the participant has no preconceptions about this ability. In reality, there is no such skill as contrast sensitivity. To study contrast sensitivity, the participant is told that she and a partner will be working collectively on a task. The participant is told that her partner is physically located in another room using a desktop computer just like her, but they will be working together in the same virtual environment. At this point, the viewpoint in the VE changes so that the participant sees another person in the room, a photorealistic male. In reality, the “partner” is not another person, but a computer-generated avatar. The experimenter then asks the male avatar to look into the web camera on top of his

computer and introduce himself to the participant, and then asks the participant to do the same. The desktop computer monitor has a web camera on top of it so that the participant believes that her face is being recorded and shown to her partner, just as she believes that her partner's face is being recorded by his web camera and shown to her. Once the introductions are made, the viewpoint moves back to its original orientation so that the participant no longer sees her "partner."

Next, the experimenter describes the contrast sensitivity task. The participant is told that a series of 25 slides will be shown by the projector in the virtual environment. Each slide contains two arrays consisting of black and white rectangles. The participant is asked to decide which array has more white area and is advised that there is one correct answer for every slide. This facilitates the development of task-orientation (scope condition of SCT) on the part of the subject. By telling participants that each slide has only one correct answer, they are encouraged to pay attention to the slides in order to do well on the task. In reality, both arrays contain nearly equal amounts of black and white area.

Once the participant indicates which array she thinks contains more white area, she is shown her partner's response, which in reality is generated by the computer. At this time, she is given the option to change her answer based on the information she gained from her partner. The participant is told to carefully consider her partner's answer, an instruction that fulfills the SCT scope condition of collective orientation.

To further build task orientation, the participant is told that her team will earn one point for every correct answer from each participant for a possibility of 50 points and the team will be paid 25 cents for every point. The total earnings for the team will be split between the two participants at the end of the study. This helps build task orientation because it motivates the participants to be successful on the task.

In the next step, the experimenter states that previous research shows that individuals who have more time and information to complete the task tend to do better

than individuals who do not have this additional time or information. To reinforce this point, the experimenter tells the participant that previous research shows that for individuals who complete the task alone, a score of 0 to 10 is poor performance, 11 to 15 is average performance, and 16 to 25 is superior performance. The participant is then told that for participants who have the opportunity to see a partner's choice before submitting their final answer, a score of 0 to 26 is poor performance, 27 to 32 is below average performance, 33-40 is average performance, 41-47 is above average performance, and 48-50 points is superior performance. This facilitates the development of collective orientation (a second scope condition of SCT) by the subject because it motivates participants to pay attention to their partner's responses on the task.

The virtual experimenter then advises the participant that previous research has found that males tend to do better than females on the contrast sensitivity task, though the reasons for these findings have not been determined. Telling the participant that men do better at the task than women introduces a status distinction. According to SCT, this distinction should lead to an expectation that men will do better on the task, thus giving men higher status and leading to the likelihood that they will exercise influence over lower-status (female) actors. Therefore, I expect that the female participants will be likely to change their initial answers based on the expectation that the males will perform better than them on the task because they are males (i.e., the males have more status than they).

Once the participant completes all 25 trials, she completes a questionnaire, notifies the research assistant, and is thanked for her participation and debriefed (see Appendix D). She then fills out a payment voucher to receive payment for her participation (see Appendix E).

Dependent Measure

For 20 of the 25 trials, the computer generates an initial partner response that is opposite that of the participant's initial response. These responses are called the "critical trials," for they afford the opportunity for the participant to be influenced by her male partner. Influence is operationalized and measured by the number of times that the participant changes her initial responses on these critical trials. To be consistent with previous research, a P(S) value is calculated for each participant. P(S) is calculated by dividing the number of times that a participant *stays* with her initial response, divided by the total number of critical trials. Therefore, high P(S) values indicate little influence by the computer-generated male partner over the female participant, whereas low P(S) values indicate high levels of influence by the partner.

According to my derivation, I expect to find the P(S) values for participants in the sterile room to be the highest because the sterile room undermines the sense of a social environment, therefore making social norms that govern social interaction, including status-organizing processes, less salient and leading a lower-status (female) participant to stay with her initial answers more often on the contrast sensitivity task. I also expect to find the P(S) values for the room with color and textures to be lower than the sterile room, because color and textures may facilitate the creation of a social environment, allowing expectations of interaction and the norms that govern this interaction to become more salient, thus leading to a lower-status (female) participant to change her initial answers on the contrast sensitivity task more often. Finally, I expect to find the P(S) values for participants in the room with color, textures, and the objects to be the lowest because the color, textures, and objects create the most social environment, making status-organizing processes most salient and leading a lower-status (female) participant to change her initial answers on the contrast sensitivity task most often.

Post-Experiment Questionnaire

Once participants complete the contrast sensitivity task, they complete a questionnaire (see Appendix F). To determine whether my attempts to manipulate task orientation and collective orientation were successful, Question 1 asks “How important was it to you to do well on the task?” and Question 2 asks “How important was it to you to consider the opinions of your fellow group member?” Participants enter their answer on a computerized slider scale ranging from 0 to 100 with 0 meaning “Not at All Important” and 100 meaning “Extremely Important.” Using similar sliding scales with 0 meaning “Not at all Competent” and 100 meaning “Extremely Competent,” Question 3 asks “How competent do you feel that you are at the contrast sensitivity task?” and Question 4 asks “How competent do you feel that your partner is at the contrast sensitivity task?” Questions 3 and 4 determine whether my status distinction manipulation had an effect.

Questions 5-8 on the questionnaire assesses the socialness of the environments by asking the participants about interactions in the rooms and to what extent they thought that the rooms were places for people. They are answered using computerized sliding scales ranging from 0 to 100. Question 5 asks “To what extent do you think a person who enters a room like the one you were in today would expect to find another person in the room?” with 0 meaning “Would Not Expect to Find Anyone Else At All” and 100 meaning “Would Definitely Expect to Find One or More Other People.” Question 6 asks “To what extent do you think that this room is conducive to a group working on a project like the one you worked on today?” with 0 meaning “Not at All Conducive to Group Project Work” and 100 meaning “Highly Conducive to Group Project Work.” Question 7 asks “When you met your partner in the room, how surprised were you to see that there actually was another person in the room?” with 0 meaning “Not at All Surprised” and 100 meaning “Extremely Surprised.” Lastly, Question 8 asks “To what extent do you believe that this room would be conducive to a social gathering of people, such as a

party?” with 0 meaning “Not at all Conducive to a Social Gathering” and 100 meaning “Highly Conducive to a Social Gathering.” The results of these questions allow me to assess whether participants considered these rooms social environments.

Finally, Questions 9-11 allow me to assess the plausibility of an alternative set of hypotheses. This set of hypotheses asserts that colors, textures, and objects that are added to a virtual room induce feelings of relaxation in the participants. To the extent that participants feel relaxed, they may be more likely to feel comfortable taking risks. As participants become more comfortable taking risks, they begin to violate status expectations. The questions that address these alternative hypotheses also use computerized sliding scales ranging from 0 to 100. Question 9 asks “How relaxed did you feel in the virtual room?” with 0 meaning “Not at all Relaxed” and 100 meaning “Extremely Relaxed.” Question 10 asks “How comfortable would you feel taking risks in the virtual room, such as not conforming to expected behavior?” with 0 meaning “Not at all Comfortable Taking Risks” and 100 meaning “Extremely Comfortable Taking Risks.” Lastly, Question 11 asks “If you were to observe someone in the virtual room who knowingly acted contrary to what was expected of them, how harshly would you judge them?” with 0 meaning “Not at all Harshly” and 100 meaning “Extremely Harshly.”

RESULTS

Participant Information

Sixty-three participants participated in the study. After 60 trials were completed, I found that the data from three cases were unable to be used and were replaced. The first case that could not be used resulted from a program malfunction that did not accurately record the data. The second case resulted from incomplete data due to a fire alarm, and the third case was dismissed and replaced due to suspicion – the participant reported during the debriefing session that she did not act as if her partner was real throughout the study. Of the 60 cases remaining after replacement, four were removed from the analysis because the participant reported her own competence on the task as higher than that of her partner's competence and because their P(S) values were greater than .59. By rating themselves as more competent than their partners, these participants indicated that they did not perceive their partners as higher-status than themselves, thus undermining the process of social influence suggested by SCT. According to a formal model developed by Fisek, Norman, and Nelson-Kilger (1992) that was based on a meta-analysis of previous SCT studies, a lower-status female should have a P(S) value of about .59 when interacting with a higher-status male. Having a P(S) value greater than .59 indicated that the participant acted on her professed assertion that she believed her status was higher than her partner's and justified exclusion from the analysis. As a result, the analysis included 56 cases.

Status Manipulation Check

To check whether the status manipulation was effective, each participant reported her own perceived competence on the contrast sensitivity task as well as her perception of her partner's competence on the contrast sensitivity task on the post-experiment questionnaire. Mean differences between perceived self competence and perceived partner's competence for each condition and the standard deviations for these means are

reported in Table 1. In addition to the four cases excluded from the analysis, there were seven more cases in which the participant rated her perceived competence as greater than or equal to that of her perception of her partner's competence. Because these participants indicated that they were better at the contrast sensitivity task than their partners, it initially appeared that the status manipulation did not work in these seven cases, as participants were told that males tend to do better at the contrast sensitivity task than females. The $P(S)$ values for these seven cases were less than the Fisek, et al. (1992) estimates, however. In their meta-analysis, Fisek et al. (1992) predicted that a lower-status female interacting with a higher-status male should have a $P(S)$ value of about .59. Though they rated their self-competence as higher than their partner's competence, having a $P(S)$ value less than .59 indicates that these seven participants were influenced more than expected by their partners, revealing that their reports of self-competence and their partner's competence were probably not an accurate measure of their actual competency expectations on the task. As a result, their data were included in the analysis.

Table 1. Means and Standard Deviations (in parentheses) for Competence Difference, Socialness, Task Orientation, Collective Orientation, and P(S)

	Condition 1 (Sterile) N=17	Condition 2 (Textures) N=19	Condition 3 (Objects) N=20
Competence Difference	13.94 (21.63)	27.79 (22.22)	17.15 (16.60)
Socialness	49.38 (16.79)	51.97 (13.48)	59.05 (21.42)
Task Orientation	70.59 (10.12)	66.32 (11.79)	65.30 (23.38)
Collective Orientation	67.06 (13.62)	72.63 (14.39)	75.65 (12.85)
P(S)	.415 (.190)	.374 (.158)	.368 (.105)

The means of the differences between the participant's perceived self-competence and the perceived competence of their partners show that the status manipulation was effective in all three conditions (i.e., participants reported that their partners were more competent on the contrast sensitivity task than themselves). The reported means seem to vary across condition, but the standard deviations show much variation in the data. An ANOVA on these data reveals that there is no significant effect of condition on differences between perceived self competence and perceived competence of one's partner, $F(2,53) = 2.38, p = .10$.

Socialness Variable

To determine the perceived "socialness" of the three VEs used in the study, all participants were asked four questions on the post-experiment questionnaire (Questions 5-8) to assess this construct. After Question 7 was reverse-coded, I conducted a principle components factor analysis on the responses to these four questions by all 56 participants

included in the analysis. The results yielded two factors with eigenvalues greater than one without rotation. The results of this factor analysis are reported below in Table 2.

Table 2. Un-rotated Factor Analysis of Socialness Questions

	Factor	Factor
To what extent do you think a person who enters a room like the one you were in today would expect to find another person in the room?	.784	.133
To what extent do you think that this room is conducive to a group working on a project that the one you worked on today?	.830	.086
When you met your partner in the room, how surprised were you to see that there actually was another person in the room?	.219	.877
To what extent do you believe that this room would be conducive to a social gathering of people, such as a party?	.611	-.555

The questions “To what extent do you think a person who enters a room like the one you were in today would expect to find another person in the room?” and “To what extent do you think that this room is conducive to a group working on a project like the one you worked on today?” loaded onto the same factor. The factor loadings for these two questions were .789 and .833, respectively. Because these two questions appear to be measuring the same construct, presumably “socialness,” (per my aforementioned proposed definition of a social environment), I constructed a new socialness variable to measure how social the participants perceived the VEs by taking the mean of the responses to these two questions for every participant. Though the question “To what extent do you believe that the virtual room would be conducive to a social gathering of people, such as a party?” also loaded onto Factor 1 with a factor loading of .611, it was not included in the constructed socialness variable because of concerns related to face validity. The question did not refer to a task-oriented situation. The influence that SCT predicts occurs only when the scope condition of task orientation is met.

The means and standard deviations for this constructed socialness variable are reported in Table 1. The mean increases slightly from Condition 1 to Condition 2 and a greater increase is observed from Condition 2 to Condition 3. The standard deviations suggest much variation in the data, and responses from participants in Condition 3 reveal the most variation. Consistent with my argument, the socialness of the VEs increases across condition; the addition of color, textures, and objects had a positive impact on how social the participants perceived the VEs. An ANOVA on the constructed socialness variable, however, reveals that this observed positive impact of simulated physical elements and objects on perceived socialness of the VEs is not significant, $F(2,53) = 1.52, p = .23$. Given that the means for socialness were in the hypothesized direction, the ANOVA may be revealing a weak manipulation of socialness.

Scope Conditions

The expected influence that SCT posits occurs only when the scope conditions of task orientation and collective orientation are achieved. To assess whether these two scope conditions were met, each participant was asked how important it was to her to do well on the task (task orientation) and how important it was to her to consider the opinions of her fellow group member (collective orientation) on the post-experiment questionnaire. The means and standard deviations of these responses are reported in Table 1.

The means show that task orientation decreased across condition; a decrease from Condition 1 to Condition 2 is shown, as well as a slight decrease from Condition 2 to Condition 3. The lowest value reported from all participants was 10 (out of a possible 100), indicating that all participants reported at least some task orientation. Therefore, no participants were excluded from the analysis as a result of lack of task orientation. The standard deviations seem to show near similar variation in Conditions 1 and 2, while the variation in Condition 3 is much greater. Overall, the means suggest that it became less

important for participants to do well on the task as color, textures, and objects were added to the virtual rooms. An ANOVA assessing condition effects revealed that the means were not significantly different from one another, $F(2,53) = .52, p = .601$.

As opposed to task orientation which decreased across condition, collective orientation increased across condition. Additionally, the variance in the responses does not seem to differ much by condition. The lowest value in response to this question was 40, showing that all participants were collectively oriented. As a result, no participants were excluded from the analysis for not meeting the collective-orientation scope condition. As colors, textures, and objects were added to the VEs, participants reported greater consideration of their partner's opinions before they submitted their final answers on the contrast sensitivity task. This is consistent with increased socialness of the rooms across conditions. An ANOVA on these means, however, revealed that there was no significant difference in collective orientation across condition, $F(2,53) = 1.86, p = .166$.

Social Influence

The P(S) value calculated for each participant is indicative of how much each of the participants was influenced by her computer-generated partner. P(S) is calculated by dividing the number of times the participant stays with her initial answer by the total number of critical trials. The lower the P(S) value, the more influence the participant experienced during the experiment. The means and standard deviations of the P(S) values by condition are reported in Table 1. Consistent with my theory, the mean P(S) value decreased across condition, revealing increasing influence across condition. My theory suggested that as colors, textures, and objects are added to a virtual room, the participants would perceive the rooms as more social and therefore uphold social expectations, thereby being subject to greater influence in a status-differentiated group. Similar to the means, the standard deviations show that the variation in the amount of influence experienced by the participants also decreased across the conditions. The

results show that as colors, textures, and objects are added to a VE, a lower-status actor was subject to more influence by a higher-status actor. Though these differences in amount of influence across condition are in the hypothesized direction, an ANOVA reveals they are not significantly different from one another, $F(2,53) = .50, p = .607$.

It is interesting to note that my P(S) values are much lower than the model proposed by Fisek et al. (1992) would suggest. That model suggests that a lower-status female working with a higher-status male should have a P(S) of about .59. The closest value to .59 that I achieved in my experiment was .415 in Condition 1. Hence, in the condition with the least amount of influence occurring, participants in my experiment still changed their answers three-to-four more times (out of 20) than would be expected from the Fisek et al. (1992) model. In an experiment testing the impact of protocol variation in experimentation, Troyer (2001) suggests that small variations in the SES protocol may have a significant impact on P(S) values. She suggests that as it becomes more important for participants to do well on a task, they seek out and pay additional attention to cues that help them determine the status of fellow group members. As opposed to the standardized SES protocol, participants in my study saw a virtual representation of their partner. Participants in other SCT studies that follow the SES either do not see their partners or are shown a video image of them. Therefore, it is possible that the virtual representation of the partner used in my experiment acts as a status cue that helps participants determine the status of their partners relative to their own status. If the virtual representation of their partner did, in fact, act as a status cue, then it is possible that participants in my study determined that their partners had more status than partners in studies where participants do not see their partners or see a video image of their partners. This higher perceived status would then result in the lower P(S) values observed in my study.

Additional Analysis

Questions 9-11 were included on the Post-Experiment Questionnaire to assess the plausibility of an alternative set of hypotheses being true. The alternative set of hypotheses suggests that as colors, textures, and objects are added to the virtual rooms, participants may feel more relaxed. As participants feel more relaxed, they may be more willing to take risks. To the extent that participants are willing to take risks, they may violate status expectations. Therefore, if the preceding hypotheses were true, then adding colors, textures, and objects to a room would result in increasing P(S) values across condition as participants would not succumb to influence from their higher-status partner. The means and standard deviations of the responses to Questions 9-11 are reported in Table 3.

Table 3. Means and Standard Deviations (in parentheses) for the Alternative Hypotheses Questions

	Condition 1 (Sterile) N=17	Condition 2 (Textures) N=19	Condition 3 (Objects) N=20
How relaxed did you feel in the room?	56.29 (22.65)	55.84 (13.99)	68.25 (20.15)
How comfortable would you feel taking risks in the room, such as not conforming to expected behavior?	50.59 (21.77)	56.00 (18.94)	56.00 (28.03)
If you were to observe someone in the room who knowingly acted contrary to what was expected of them, how harshly would you judge them?	38.82 (20.82)	45.11 (16.32)	34.95 (17.38)

The results suggest that participants in Condition 3 felt much more relaxed than did participants in Conditions 1 and 2, which is consistent with the alternative hypotheses. The alternative hypothesis, however, would also suggest that participants in Condition 2 would report more relaxation than participants in Condition 1, but this did

not occur. Participants in Conditions 2 and 3 reported a slightly higher propensity to take risks than participants in Condition 1, which is suggested by the alternative hypothesis, but the increase in risk taking behavior from Condition 2 to Condition 3 that the alternative hypothesis would also suggest did not occur. Finally, the alternative hypotheses would suggest a decreasing tendency to harshly judge someone who was knowingly acting contrary to expectations (Question 11), but the reported means do not provide strong support for this theory.

If the argument were true that colors, textures, and objects elicit relaxation, relaxation elicits risk-taking, and risk-taking elicits violations of status expectations, then correlations of the responses to the last three questions on the post-experiment questionnaire should provide evidence of this mechanism. We would expect to find a significant, positive correlation between reported feelings of relaxation and risk taking behavior. Also, a significant, negative correlation would be expected between risk taking behavior and harshly judging someone who knowingly acted contrary to expectations. These correlations are reported in Table 4.

Table 4. Correlations and Significance between Questions 9-11

	Condition 1 (Sterile) N=17	Condition 2 (Texture) N=19	Condition 3 (Objects) N=20	All Conditions
How relaxed did you feel in the room?	-.158	.175	.451 [*]	.192
How comfortable would you feel taking risks in the room, such as not conforming to expected behavior?				
How comfortable would you feel taking risks in the room, such as not conforming to expected behavior?	.197	-.146	-.362 ⁺	-.114
If you were to observe someone in the room who knowingly acted contrary to what was expected of them, how harshly would you judge them?				

* $p < .05$; + $p < .10$

The reported correlations do not provide strong support for the alternative hypotheses. The only condition in which the correlations are in the predicted direction and of significance is Condition 3. It should be noted, however, that the correlation between risk taking behavior and harshly judging someone who knowingly acted contrary to expectations in Condition 3 is only marginally significant. In addition, the alternative argument would suggest that the reported correlations be significant and in the hypothesized direction in all conditions, which did not occur. Overall, the results do not provide strong support for the alternative thesis.

Overall, the data provide more support for the initial argument that colors, textures, and objects elicit the creation of a social environment, which may cause occupants or observers of the social environment to expect interaction within that space and to subject that interaction to the social rules and norms that guide human interaction. While it appears that these potential effects are weak, the data seem to show that they may be present. Therefore, if color, textures, and objects

are included in a room, then a lower-status actor may be subject to greater influence from a higher status actor in a status-differentiated group than if color, textures, and the objects were not included.

DISCUSSION

This study examined the effects of adding colors, textures, and objects to virtual environments on social influence. It was hypothesized that as colors, textures, and objects were added to virtual environments, study participants would consider the environments to be more social. As the virtual environments became more social, it was hypothesized that participants would pay more attention to social norms and expectations, thus leading to the participants being subject to more influence in a status-differentiated group. While it was observed that participants perceived VEs with colors, textures, and objects as more social and were influenced more as colors, textures, and objects were added to the virtual environments, inferential statistics revealed that the means of both the socialness measure and the influence measure were not significantly different from one another by condition. Given that these means were in the hypothesized direction, however, it is possible that the effect sizes were small and that a greater sample size may reveal significance.

Examination of the data reveals that participants in the third condition (objects) reported that the environment was more social than participants in the first condition (sterile) and the second condition (textures). These participants also reported less task orientation, more collective orientation, and were subject to more influence than participants in the first two conditions. A potential mechanism that may explain these outcomes is that as an environment becomes more social, participants give greater consideration to the opinions of their partners and as a result are subject to more influence by their partners. In addition, collective orientation may have more of an impact in the social influence process than task orientation. This proposal could be investigated by future researchers.

While the hypotheses were not fully supported in this study, perhaps one of the most interesting findings is that the social psychological process of influence does, in

fact, occur in virtual space. Not only did social influence occur in the virtual environments, but there was also a greater amount of influence than would be suggested by previous research. As previously mentioned, the fact that a greater amount of influence occurred in this study than would be expected by the Fisek et al. (1992) estimates may be due to the fact that participants saw a virtual representation of their partner. The standardized experimental setting protocol for SCT research calls for either a video representation of the partner or no representation of the partner when an experiment is conducted in a computer-mediated (chat-room) environment. That is, all of the information that participants obtain about their partner in the SES for computer-mediated environments is from the experimenter. Troyer (2001) suggests that as it becomes more important for participants to do well on a task, they seek out additional information that helps them determine the status of their partners vis-à-vis their own status. Therefore, it is possible that the participants in this study used the virtual representation, as opposed to a video representation or no representation, of their partner as a status cue to help them determine their partner's status, even though it was only briefly presented. The fact that the partner's representation in my experiment was virtual may have had a unique impact not observed in previous studies. As a result, one must use caution when comparing the results of this study to previous SCT studies, as a slight variation in my protocol may have led to a greater amount of social influence than if the variation were not included in my procedures. Nonetheless, it appears that people may be affected more by status in virtual environments compared to other modes of communication.

Even though influence may be more pronounced in virtual settings, virtual environment technology seems to be a viable instrument to study SCT as well as other social psychological processes. VEs make it possible to conduct research that could not have previously been performed without suffering a vast loss of control. For example, SCT theorists have often claimed that age is a status characteristic. VEs make it possible

to test this claim in a novel way. Using digital imaging software, one can take photographs of an individual and then age the person by adding visual effects such as wrinkles and gray hair. Then, after these images are superimposed onto virtual bodies, researchers can compare the amount of influence that the person and the “aged version” of the same person exert in a VE. In this scenario, a great amount of control is preserved because there are not two different confederates participating in the study. Rather, the experimenter utilizes two different, digital versions of the same person. Additionally, one can study the effects of stigma or skin color in the same way. An experimenter can digitally alter specific appearance details of people, which offers superb amounts of control.

While researchers know much about social psychological process that occur in face-to-face settings, less is known about these processes in computer-mediated settings, and even more specifically, virtual settings. As applications such as networked virtual video games, computer-mediated conferencing software, and social networking websites come to be used widely in our society, it is important that we understand how social psychological processes occur within these applications. This study suggests that the social psychological process of influence may operate similarly across communication mediums, though it may be more pronounced in virtual settings. In other words, computers do not seem to act as a barrier to influence, and they may actually augment influence. This is cause for concern as millions of Americans frequent social networking websites such as MySpace.com and Facebook.com where opportunities for people to exploit influence are numerous. Further research is warranted to understand how social psychological processes occur not only in computer-mediated settings, but more specifically, in virtual settings.

APPENDIX A
RECRUITMENT FORM

SOCIOLOGY RESEARCH PARTICIPANTS INVITED.
Scheduled AT YOUR CONVENIENCE and ON CAMPUS

The University of Iowa Department of Sociology is looking for students to participate in different research projects. Generally, it entails between one and two hours of your time scheduled *at your convenience*. You may participate in as many studies as you like *as long as each study is different*. Compensation is available.

The research takes place in the Department of Sociology Center for the Study of Small Group Processes in Seashore Hall. Research topics include impression formation, decision making, paranormal beliefs, bargaining and negotiating, communication, and group problem-solving. *No specific skills are necessary for you to qualify.*

If you wish to be contacted for possible participation, please complete this form and return it to the Dept. of Sociology office at W140 Seashore Hall.

NAME: _____ PHONE: _____

BEST TIME(S) TO REACH YOU: _____

GENDER: _____ AGE: _____ YEAR IN SCHOOL: _____ MAJOR: _____

Have you ever participated in a study for the Dept. of Sociology? (check one) _____ Yes. _____ No.

If YES, briefly describe the study. _____

APPENDIX B

TELEPHONE SCHEDULING SCRIPT

Hello, _____, my name is [research assistant's name]. I'm calling from the Center for the Study of Group Processes at the University of Iowa. Earlier this year, you filled out a form in one of your classes indicating that you might be interested in participating in a research study. The reason I'm calling is that we are inviting individuals to participate in a new study. The study I am scheduling for right now is called "Computer Conferencing." The study involves working on a task over a computer network. The study takes about one hour, and you will be paid approximately \$12.50 for your time. Are you interested?

IF the student is *not* interested:

No problem. Would you still like to be contacted in the future for possible participation in another study, or would you like to be taken off of the Center's calling list?

IF the student would still like to be *contacted* in the future:

Great. We may contact you again in the future. Thank you for your time. Good-bye.

IF the student would like to be *taken off the list*:

Ok, I will take you off our list. Thank you for your time. [Remove the person's contact information from the pool].

IF the student is *interested*:

Great. We have openings on (day of week and date) at (time) and (day of week and date) at (time). Will either of those work for you?

IF one opening *works* for the person, write her name on the schedule.

IF *neither opening works* for the person, offer two new times:

How about (day of week and date) at (time) or (day of week and date) at ____ (time)?

IF one opening *works* for the person, write her name on the schedule.

IF *neither opening works* for the person, inquire when the person is available:

What times would be best for you to come in?

IF we *do not* have an opening during those times:

It doesn't appear that our schedules match up right now. Would it be alright if we called you in the future? [Wait for response.]

IF *yes*:

Great, we may contact you again in the future, then.
Thanks for your time. Good-bye.

IF no:

Ok. I will take your name off our list. Thanks for your time. [Remove the person's contact information from the pool].

IF we have an opening during those times, write the person's name on the schedule:

We have an opening at (time) on (day of week and day) that fits your schedule. I'll put you down for that time.

Give directions to Seashore Hall:

The study takes place at Seashore Hall. Seashore Hall is the next building after Van Allen going East, away from the Pentacrest. It is at the intersection of Linn and Jefferson streets.

Give directions to Appropriate Waiting Room: In Seashore Hall, the room you'll go to is called the Alpha Waiting Room. To get to it, enter Seashore Hall through the Jefferson Street entrance. Go down the stairs into the basement. The second door on the left-hand side is the Alpha Waiting Room. Go in there, have a seat, and someone will meet you at (time).

Give the following cancellation information:

If you are unable to make your appointment, it is important that you contact us as early as possible so we can try to find a replacement. You may send an email including your name and the date and time of the scheduled appointment you will miss to Brian at brian-johnson@uiowa.edu. Thank you for agreeing to participate, and we'll see you soon.

APPENDIX C

INFORMED CONSENT DOCUMENT

Project Title: **Interaction in Virtual Environments**
Research Team: **Brian Johnson, BS**
Lisa Troyer, PhD

This consent form describes the research study to help you decide if you want to participate. This form provides important information about what you will be asked to do during the study, about the risks and benefits of the study, and about your rights as a research subject.

- If you have any questions about or do not understand something in this form, you should ask the research team for more information.
- You should discuss your participation with anyone you choose such as family or friends.
- Do not sign this form unless the study research team has answered your questions and you decide that you want to be part of this study.

WHAT IS THE PURPOSE OF THIS STUDY?

This is a research study. We are inviting you to participate in this research study because we received a form from you indicating your interest in participating in research being conducted by investigators at the Center for the Study of Group Processes. You may recall that a representative from The Center visited one of your classes early this year, explained some research projects being conducted at The Center, and invited interested participants to fill out a form indicating that they would like to be considered as possible research participants. We received one of these forms from you.

The purpose of this research study is to learn about how people interact to solve problems over computer networks.

HOW MANY PEOPLE WILL PARTICIPATE?

Approximately 100 people will take part in this study at the University of Iowa.

HOW LONG WILL I BE IN THIS STUDY?

If you agree to take part in this study, your involvement will last for about an hour.

WHAT WILL HAPPEN DURING THIS STUDY?

If you agree to participate in this study, you will work on a computer network to solve problems.

You will also be asked to answer some questions regarding your experience in the study. You will view the questions on a computer terminal and enter responses through the computer. You are not required to answer any question that you are asked during the course of your participation in this study. You may skip any questions that you would prefer not to answer. Finally, you will have the opportunity to discuss your participation in the study with the researcher.

This study will be conducted in the Center for the Study of Group Processes, in Seashore Hall.

WHAT ARE THE RISKS OF THIS STUDY?

There are no foreseeable physical risks associated with participation in this study. You may feel some anxiety during your participation, resulting from the level of difficulty of the problems.

WHAT ARE THE BENEFITS OF THIS STUDY?

We don't know if you will benefit from being in this study.

However, we hope that, in the future, other people might benefit from this study because the knowledge that we could gain from it may help us better understand how people interact over computer networks.

WILL IT COST ME ANYTHING TO BE IN THIS STUDY?

You will not have any costs for being in this research study.

WILL I BE PAID FOR PARTICIPATING?

You will be paid for being in this research study. You will need to provide your social security number (SSN) in order for us to pay you. You may also need to provide your address if a check will be mailed to you.

You will be paid \$12.50 for participating in this research study.

WHO IS FUNDING THIS STUDY?

The University and the research team are receiving no payments from other agencies, organizations, or companies to conduct this research study.

WHAT ABOUT CONFIDENTIALITY?

We will keep your participation in this research study confidential to the extent permitted by law. However, it is possible that other people may become aware of your participation in this study. For example, federal government regulatory agencies, auditing departments of the University of Iowa, and the University of Iowa Institutional Review Board (a committee that reviews and approves research studies) may inspect and copy records pertaining to this research. Some of these records could contain information that personally identifies you.

To help protect your confidentiality, any personally identifying information about you will be stored separately from your data (your data includes the tasks you complete individually). We will use an identification number and not your name or other information that could personally identify you on all data collected for the study. Your signed consent form and payment form will be stored separately from the study data.

If we write a report or article about this study or share the study data set with others, we will do so in such a way that you cannot be directly identified.

IS BEING IN THIS STUDY VOLUNTARY?

Taking part in this research study is completely voluntary. You may choose not to take part at all. If you decide to be in this study, you may stop participating at any time. If you decide not to be in this study, or if you stop participating at any time, you won't be penalized or lose any benefits for which you otherwise qualify.

WHAT IF I HAVE QUESTIONS?

We encourage you to ask questions. If you have any questions about the research study itself, please contact Brian Johnson at 335-2864 or brian-johnson@uiowa.edu or Lisa Troyer at 335-2484 or lisa-troyer@uiowa.edu

If you have questions, concerns, or complaints about your rights as a research subject or about research related injury, please contact the Human Subjects Office, 340 College of Medicine Administration Building, The University of Iowa, Iowa City, Iowa, 52242, (319) 335-6564, or e-mail irb@uiowa.edu. General information about being a research subject can be found by clicking "Info for Public" on the Human Subjects Office web site, <http://research.uiowa.edu/hso>.

This Informed Consent Document is not a contract. It is a written explanation of what will happen during the study if you decide to participate. You are not waiving any legal rights by signing this Informed Consent Document. Your signature indicates that this research study has been explained to you, that your questions have been answered, and that you agree to take part in this study. You will receive a copy of this form.

Subject's Name (printed):

(Signature of Subject)

(Date)

Statement of Person Who Obtained Consent

I have discussed the above points with the subject or, where appropriate, with the subject's legally authorized representative. It is my opinion that the subject understands the risks, benefits, and procedures involved with participation in this research study.

(Signature of Person who Obtained Consent)

(Date)

APPENDIX D

DEBRIEF SCRIPT

Thanks for participating in our study today. Before you leave, I would like to tell you a bit more about the study and answer any questions you may have.

- First, let me begin by inviting you to tell me about your impressions of the study. Did you have any questions about the virtual environment used in today's study? [Record questions, responses; note suspicions.]
- What objects do you recall that were in the room? [Record subject response.]
- What can you tell me about the walls of the room? About the ceiling? About the floor? [Record subject response.]
- What were your initial impressions of the virtual environment; what did you think of it? [Record subject response.]
- Do you think that these impressions might have affected your responses in the task you completed during the experiment? If so, how? [Record subject response.]

As we advised you earlier, this is an experimental study of computer-mediated interaction. We are interested in understanding how status of partners in interaction is perceived when people interact over computer networks. Prior research shows that in face-to-face settings, when a higher-status person interacts with a lower-status person, the lower-status person tends to defer to the opinions of the higher-status actor. We are interested in understanding if this same thing happens when in the interaction occurs in a computer-mediated setting instead of a face-to-face setting. Also, we are interested in how the simulated physical elements and properties of virtual environments, like the one you saw on your computer, affects how people are influenced. People have much control over the simulated physical properties in virtual environments, and we specifically want to see if people are influenced in the same ways in virtual environments with different simulated physical properties as they are in face-to-face environments.

To investigate this, our experiment has three conditions. All participants complete the same task you completed, but the virtual environment is altered in the three different conditions. Today, you were assigned to [Insert description of participant's condition from below]. In other sessions of our study, participants are assigned to different conditions, with different virtual environments [Describe two other conditions as below].

Condition Descriptions:

Condition 1 (Sterile Environment): In this condition, the environment is very sterile

Condition 2 (Color and Texture): In this condition, the environment includes only wall color, ceiling color, floor color, and textures on these surfaces.

Condition 3 (Color, Texture, and Objects): In this condition, the environment includes wall color, ceiling color, floor color, textures on these surfaces, and 4 objects, namely, a potted plant, a rug, artwork, and a comfortable-looking chair.

Now, in the study, we represented your partner as another participant in our study. Yet, your partner was not actually a participant. Rather, he was a computer-generated actor, not a real person, that was pre-programmed to generate particular responses to each of the contrast sensitivity problems.

Your partner was not a real participant because we wanted to ensure that all of the participants are exposed to exactly the same kind of interaction as you were. This way,

we can investigate how people react to the responses they believe the partner is making and whether (and how much) they are influenced by the responses of the partner.

In addition, you may have noticed that you and the actor portraying your partner seemed to have different initial choices on many of the contrast sensitivity problems. In reality, as I have already explained, the partner was not making choices. These were pre-programmed. When people have different initial opinions about something, one way to assess if they are influenced is to see if they change their initial opinion to go along with the other person's. Thus, by programming the initial choice of your partner to differ from those of participants in the study, we can assess how much a participant is influenced by the other.

In reality, the contrast sensitivity task that you completed does not have right or wrong answers. This is about the same amount of white area on all of the pairs of problems. Also, the task does not actually measure a real ability, like "Contrast Sensitivity." Consequently, the answers you provided do not speak to any abilities you may or may not have. Rather, we used this task and the pre-programmed differing choices of participants and the actor to assess influence. We are investigating whether the simulated physical elements and properties of virtual environments affects influence.

Additionally, we had advised you that you would receive 50 cents for each correct answer (up to \$12.50). Since there are no correct answers, however, we are giving all participants the maximum amount they are told they can earn. So, you will receive \$12.50.

Again, the task today does not correspond to known abilities. Also, I want you to know that our interests are not in deceiving you. We are interested in learning your and other participant's honest responses to these kinds of situations. To ensure that we did indeed learn your honest response, however, we could not tell you all of these details until the study was completed. I hope that you understand the reasons for all of the events that occurred in this study. Do you have any questions about what occurred? [Record any questions, and answer all questions.]

Your participation in the study today has been extremely helpful to us. Some important questions, like how people respond when interacting in different virtual environments, can be answered when we have volunteers like you who are willing to help us advance science. I would like to extend our thanks to you for participating today and make sure that you know how much we appreciate your help.

[Complete the pay voucher and let participant know she will receive a check from the University for her participation. Escort participant out of the Laboratory.]

APPENDIX E

PAYMENT VOUCHER

PLEASE PRINT LEGIBLY (or payment can't be processed)

Date: _____

SOCIAL SECURITY NO.: _____

NAME: (Printed) _____
 Last First

Signature: _____

STREET/CAMPUS ADDRESS: _____ Rm/Apt # _____
(Note: if dorm address, we must have room number)

CITY & ZIP: _____

E-MAIL ADDRESS: _____

US Citizen: Yes _____ No _____ (f you checked NO, please continue below)

FOR NON-U.S. CITIZENS ONLY

If not US Citizen, what type of Visa do you have? F1 S____ J1____ Other_____

What country is Visa from _____

What is your permanent (International) home address _____

(To be filled in by RA, after completion of study)

Amount to be paid _____

RA's name: _____

APPENDIX F

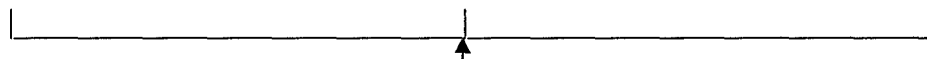
POST-EXPERIMENT QUESTIONNAIRE

Please click and drag the slider to the position on the line that corresponds with your answer.

1. How important was it to you to do well on the contrast sensitivity task?

Not at all Important

Extremely Important



2. How important was it to you to consider the opinions of your fellow group member?

Not at all Important

Extremely Important



3. How competent do you feel that you are at the contrast sensitivity task?

Not at all Competent

Extremely Competent



4. How competent do you feel that your partner is at the contrast sensitivity task?

Not at all Competent

Extremely Competent



Increasingly, work is being conducted through conferencing environments like the one you worked in today. We are interested in whether the features of rooms in these environments matter to workers. Consider the features of the room in which you worked today, such as the carpeting, colors, and objects in the room, as you answer the following questions:

5. To what extent do you think a person who enters a room like the one you were in today would expect to find another person in the room?

Would Not Expect to Find
Anyone Else at All

Would Definitely Expect to
Find One or More Other
People



6. To what extent do you think that this room is conducive to a group working on a project like the one you worked on today?

Not at all Conducive to
Group Project Work

Highly Conducive to
Group Project Work



7. When you met your partner in the room, how surprised were you to see that there actually was another person in the room?

Not at all Surprised

Extremely Surprised



8. To what extent do you believe that this room would be conducive to a social gathering of people, such as a party?

Not at all Conducive to
a Social Gathering

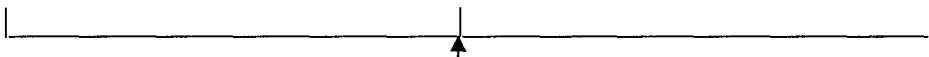
Highly Conducive to
a Social Gathering



9. How relaxed did you feel in the room?

Not at all Relaxed

Extremely Relaxed



10. How comfortable would you feel taking risks in the room, such as not conforming to expected behavior?

Not at all Comfortable
Taking Risks

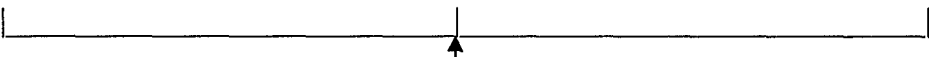
Extremely Comfortable
Taking Risks



11. If you were to observe someone in the room who knowingly acted contrary to what was expected of them, how harshly would you judge them?

Not at all Harshly

Extremely Harshly



REFERENCES

- Berger, J., Cohen, B.P., & Zelditch, M., Jr. (1972). Status characteristics and social interaction. *American Sociological Review*, 37, 241-255.
- Blascovich, J. (2002, September-October). A theoretical model of social influence for increasing the utility of collaborative virtual environments. Paper presented at the ACM Collaborative Virtual Environments Conference, Bonn, Germany.
- Blascovich, J., Loomis, J., Beall, A.C., Swinth, K.R., Hoyt, C.L., & Bailenson, J.N. (2002). Immersive virtual environment technology as a methodological tool for social psychology. *Psychological Inquiry*, 13(2), 103-124.
- Brooks, F.P., Jr. (1999). What's real about virtual reality? *IEEE Computer Graphics and Applications*, 19, 16-27.
- Campbell, D.E. (1979). Interior office design and visitor response. *Journal of Applied Psychology*, 64, 648-653.
- Chaikin, A.L., Derlega, V.J., & Miller, S.J. (1976). Effects of room environment on self-disclosure in a counseling analogue. *Journal of Counseling Psychology*, 23(5), 479-481.
- Cohen, B.P. (1989). *Developing Sociological Knowledge: Theory and Method* (2nd ed.). Chicago: Nelson-Hall.
- Davis, T.R.V. (1984). The influence of the physical environment in offices. *Academy of Management Review*, 9(2), 271-283.
- Dubrovsky, V.J., Kiesler, S., & Senta, B.N. (1991). The equalization phenomena: Status effects in computer-mediated and face-to-face decision-making groups. *Human-Computer Interaction*, 6, 119-146.
- Fisek, M.H., Norman, R.Z., & Nelson-Kilger, M. (1992). Status characteristics and expectation states theory: A priori model parameters and test. *Journal of Mathematical Sociology*, 16, 285-303.
- Foschi, M. (1996). Double standards in the evaluation of men and women. *Social Psychology Quarterly*, 59, 237-254.
- Gifford, R. (1988). Light, decor, arousal, comfort and communication. *Journal of Environmental Psychology*, 8, 177-189.
- Goodsell, C.T. (1977). Bureaucratic manipulation of physical symbols: An empirical study. *American Journal of Political Science*, 21, 79-91.
- Hebl, M.R., & Kleck, R.E. (2002). Virtually interactive: A new paradigm for the analysis of stigma. *Psychological Inquiry*, 13(2), 128-132.
- Kiesler, S., Siegel, J., & McGuire, T.W. (1984). Social psychological aspects of computer-mediated communication. *American Psychologist*, 39(10), 1123-1134.

- Kwallek, N., Lewis, C.M., Lin-Hsiao, J.W.D., & Woodson, H. (1996). Effects of nine monochromatic office interior colors on clerical tasks and worker mood. *Color Research and Application*, 21(6), 448-458.
- Loomis, J., Blascovich, J., & Beall, A.C. (1999). Immersive virtual environment technology as a basic research tool in psychology. *Behavior Research Methods, Instruments, & Computers*, 31(4), 557-564.
- Maslow, A. H., & Mintz, N. L. (1956). Effects of esthetic surroundings: I. Initial effects of three esthetic conditions upon perceiving "energy" and "well-being" in faces. *Journal of Psychology*, 41, 247-254.
- McCaskey, M.B. (1979). The hidden messages managers send. *Harvard Business Review*, 57(6), 135-148.
- Mintz, N. L. (1956). Effects of esthetic surroundings: II. Prolonged and repeated experience in a "beautiful" and an "ugly" room. *Journal of Psychology*, 41, 459-466.
- Morrow, P.C., & McElroy, J.C. (1981). Interior office design and visitor response: A constructive replication. *Journal of Applied Psychology*, 66, 646-650.
- Pressly, P.K., & Heesacker, M. (2001). The physical environment and counseling: A review of theory and research. *Journal of Counseling and Development*, 79, 148-160.
- Sproull, L., & Kiesler, S. (1986). Reducing social context cues: Electronic mail in organizational communication. *Management Science*, 32(11), 1492-1512.
- Tausky, C. (1980). Prediction in applied settings. *Journal of Applied Behavioral Science*, 16, 230-233.
- Troyer, L. (2002). The relation between experimental standardization and theoretical development in group processes research. In J. Smatzka, M. Lovaglia, & K. Wysienska (Eds.). *Theory development, testing, and growth in group processes research* (pp. 131-147). Westport, CT: Praeger.
- Troyer, L. (2001). Effects of protocol differences on the study of status and social influence. *Current Research in Social Psychology*, 6(13), 182-204.
- Wagner, D. G., Ford, R.S., & Ford, T.W. (1986). Can gender inequalities be reduced? *American Sociological Review*, 51, 47-61.
- Walker, H.A., & Cohen, B.P. (1985). Scope statements: Imperatives for evaluating theory. *American Sociological Review*, 50(3), 288-301.
- Wollin, D.D., & Montagne, M. (1981). College classroom environment: Effects of sterility versus amiability on student and teacher performance. *Environment and Behavior*, 13(6), 707-716.